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CASE STUDY

E-Clay Stabilisation / Reactive Barrier

Residential Development, Birmingham

Client

midland heart
passionate about communities

Developer

THOMAS VALE construction

Environmental Consultants

GIP Ltd. Ground Investigation & Piling Limited

Site Background & History

The site is located in Nechells, Birmingham and occupies 0.49 hectares. The site was formerly occupied by ERA and was utilised for the manufacture of locks and ironmongery.

The proposed residential development on the site [by Midland Heart] comprises of 33 houses. The development is shown in Figures 1 and 2.

Figure 1 – Proposed Development

Figure 2 – Proposed Development

GIP carried out extensive site investigations to identify the nature and extent of site contamination. The main contamination sources were identified in the central area of the site (beneath the floor slab of the former building). The prime contaminants of concern were total petroleum hydrocarbons [TPH] – the analytical data confirmed the presence of elevated levels of aliphatic and aromatic C_{16} - C_{21} and C_{21} - C_{35} TPH. The nature of the contamination was consistent with historical activities on site - lubricating oils would have been widely utilised in the manufacture of locks and associated ironmongery products.

Three distinct contamination areas were identified based on analytical data provided by GIP – these areas were delineated based on a TPH threshold value of 1,000mg/kg and coincided with the historical location of machine sumps, oil storage areas, drainage runs and likely spillage areas.

The source contamination extended to depths in excess of 3.5m bgl – this was primarily due to the sandy geology associated with the site. Significant TPH concentrations were recorded within these areas (↑30,000mg/kg).

GIP also identified the presence of chlorinated hydrocarbon contamination within the groundwater, predominantly on the eastern side of the site. It was not possible to determine the contamination source from the site investigations - it was therefore assumed that the groundwater contamination was most likely due to spillages associated with historical [chlorinated hydrocarbon] degreasing activities on site and from chemical storage areas. The chlorinated hydrocarbons are likely to have formed a pollution source at depth [as chlorinated hydrocarbons are DNAPLs].

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The typical site contamination is shown in Figure 3.

Figure 3 – Typical Site Contamination

Remediation Objectives

Envirotreat were commissioned by Thomas Vale to design and implement a remediation strategy which would satisfy Environment Agency requirements for groundwater protection. GIP designed a suitable capping layer for the garden and landscaping areas to address human health requirements.

Envirotreat developed an integrated remediation strategy to address the complex and uncertain contamination identified on site. The strategy comprised of E-Clay stabilisation to treat the identified TPH source contamination in the central area of the site in combination with an E-Clay / Reductive Permeable Reactive Barrier to address residual chlorinated hydrocarbon and residual TPH groundwater contamination. The reactive barrier was designed to be installed along the northern site boundary to intercept the natural flow of groundwater migrating from the site (in the direction of the Hockley Brook and the River Tame).

Methodology

Prior to the commencement of source treatment Envirotreat undertook trial pitting to ascertain the site geology.

It was determined that the superficial deposits beneath the made ground were exclusively sandy in nature becoming ‘running sands’ with increasing depth. Bedrock was identified beneath the sandy layer. The presence of ‘running sands’ precluded the possibility of fully excavating the deeper contamination for proposed *ex-situ* E-Clay stabilisation. As a consequence it was decided to implement a combined *ex-situ* and *in-situ* treatment [stabilisation] process for shallower and deeper contamination respectively.

Envirotreat produced an Environmental Risk Assessment, a Quality Plan and Method Statement outlining the site history, contamination issues, proposed remediation strategy & technical rationale, environmental protection measures required during the remediation works and validation protocols for the treatment element of the works.

The source contamination areas were effectively delineated based on visual and olfactory observations. The source areas were extended (where necessary) to ensure that the source contamination was effectively addressed.

The stabilisation process comprised of a designated mix formulation of E-Clay and cementitious materials.

The *ex-situ* treatment process is shown in Figure 4.

Figure 4 – Ex-Situ Stabilisation

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Site constraints prevented the possibility of utilising soil mixing plant (soil cutters / augers) for the *in-situ* treatment [stabilisation]. It was therefore decided to carry out the *in-situ* treatment element utilising a conventional excavator bucket to the required depth.

The *in-situ* treatment process is shown in Figure 5.

Figure 5 – In-Situ Stabilisation

The reactive barrier was installed utilising a similar methodology to the source treatment (due to the site geology). The barrier was installed in 6m long sections to minimise the risk of collapse and most importantly to maintain the site access on the northern boundary of the site (which the barrier intercepted). The barrier sections were excavated to circa 2.5m bgl. In each case the excavation was extended to ascertain / confirm the depth of the weathered mudstone / bedrock. The mudstone is shown in Figure 6.

Figure 6 – Weathered Mudstone (at 3.2m bgl)

The requisite volumes of E-Clay and reductive chemicals were mixed with the soils installing the reactive barrier to the required depth.

On completion of the reactive barrier installation the surface layer was capped with hardcore.

The addition of E-Clay and the reductive agent is shown in Figure 7.

Figure 7 – Addition of E-Clay / Reductive Additive

The source treatment involved the excavation and ex-situ treatment of 575m^3 of shallow contaminated soils and in-situ treatment of a further estimated 250m^3 of deeper contaminated soils. The barrier was 30m in length and installed along the full north eastern boundary of the site to a depth of 3 – 3.3m bgl.

The remediation works were undertaken and completed within 8 days.

Validation

The works were undertaken in accordance with the approved Method Statement. It was agreed that the suitability of treated material for reuse on site would be determined by compliance with designated leachate target values.

On successful validation the *ex-situ* treated materials were reused on site to backfill the excavations.

Two boreholes were installed to monitor the efficacy of the E-Clay / Reductive Permeable Reactive Barrier.

Results & Conclusions

The results obtained for leach testing were below detection levels for the identified contaminants of concern. Borehole monitoring has been successful confirming that the installed reactive barrier is performing satisfactorily.

The overall remediation strategy is shown in Figure 8.

The prime drivers for the remediation works were the protection of human health and controlled waters. These objectives have been achieved.

Envirotreat has produced a comprehensive validation report confirming that the overall remediation strategy had been successfully implemented.

GIP has submitted the validation report to Birmingham City Council to enable the discharge of relevant planning conditions.

Figure 8 – Overall Remediation Strategy